

*Return to H. P. Smith*

# The Science Teacher

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Volume V

OCTOBER, 1938

Number 3

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Edwin M. Bruce

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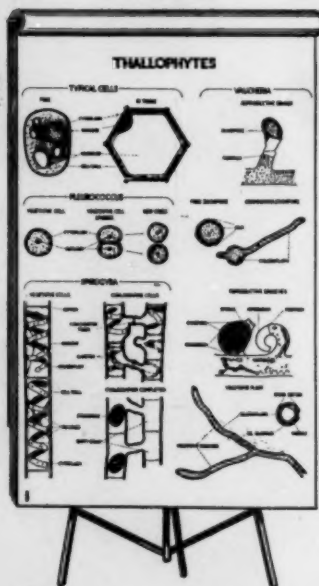
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# The Science Teacher

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## Federal Soybean Research

O. E. MAY

U. S. Regional Soybean Industrial Products Laboratory

Urbana, Illinois

The U. S. Regional Soybean Industrial Products Laboratory was organized and is financed under the provisions of the Bankhead-Jones Act, passed by Congress in June 1935, one of the purposes of the enactment of which was to promote research basic to agriculture. The laboratory is regional in its outlook and represents a cooperative venture, participated in by the Bureaus of Chemistry and Soils and Plant Industry of the U. S. Department of Agriculture and the Agricultural Experiment Stations of the States of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The broad objectives of the laboratory are: (1) To ascertain the effects of varietal, climatic, soil, and fertilizer differences on the chemical composition of the soybean, (2) and to develop new industrial uses and improve present industrial outlets for soybeans and soybean products. The research program laid down to achieve these objectives is planned by representatives of the Federal and State agencies named above, and is approved by their chiefs and directors.

The chemical work of the laboratory is organized under four projects, analytical, oil, meal, and development, and is administratively in charge of the Bureau of Chemistry and Soils. The agronomic work dealing with the cultural and genetic phases of soybean research is in charge of the Bureau of Plant Industry.

Within the past year the organiza-

tion of the laboratory has been completed and active work is now underway on the projects mentioned above.

The agronomic investigations now include experimental plots ranging from Brookings, South Dakota, on the north and west, to Sikeston, Missouri, on the south, and St. Clairsville, Ohio, on the east. These experimental plots include therefore, a very wide range of climatic and soil factors. During 1937, 43 experimental plots were planted in 6 states included in the above geographical range. Some of these plots were subdivided to provide for varietal and fertilizer studies. A number of plant breeding studies were initiated during the past year which it is hoped will eventually make it possible to ascertain trends in the inheritance of oil content, protein content, iodine number of the oil and other variables appearing in the beans derived from the resulting crosses. The results of these breeding studies are too meager at present to justify any attempts to draw conclusions, but it is enough to say that they are quite interesting and hold considerable promise for future work. In addition, facilities have been set up to carry out physiological studies of the soybean. This work also has only recently been started so that there is nothing as yet to report. In connection with the experimental plots mentioned above some progress has been made in relating chemical composition to varietal and environmental factors. Crops were harvested from these plots in 1936 and 1937 and the seed brought to Urbana where it was analyzed for

protein, oil, sugars, crude fiber, ash, phosphorus, potassium, and calcium, and iodine number, thiocyanogen number, unsaponifiable, and acid number of the oil. More than 500 samples of soybeans from the 1936 experimental plots have been analyzed, but the results of these analyses do not lend themselves to clear-cut interpretation because of the unusual weather conditions existing during the summer of that year. The analyses on the 1937 crop are not far



Press for extracting the oil. Capacity is adequate for that of a pilot plant.

enough along, as yet, to permit any conclusions to be drawn. Nevertheless certain trends seem to be indicated. Thus, for example, the potassium seems to vary little in the varieties investigated thus far while the iodine number of the oil from the different varieties does seem to vary significantly. It should be realized, of course, that until analytical results have been obtained over a period of approximately five years it would be extremely unwise to make any statements concerning the effects of soil types, climate, and varieties upon chemical composition, and the laboratory does not intend to make any such statements concerning these variable factors on the basis of the work so far accomplished. It might be of interest, however, to point out one rather outstanding example of the apparent effect of environmental factors on the composition of soybean oil. In 1936 a plot of soybeans of the Dunfield variety was grown at Columbia, Missouri. At this station the outstanding environmental conditions were mean maxima in July and August temperatures of 99.8 degrees

and 97.4 degrees, respectively, and precipitation of .97 and 1.34 inches, respectively, for the same two months. When subjected to analysis the oil derived from these beans had an iodine number of 102 which, so far as the laboratory is aware, is the lowest value ever recorded for an iodine number of soybean oil. This oil was completely analyzed in order to determine the composition of its fatty acids. It had approximately the normal saturated and unsaturated fatty acid ratio. However, it was found that its oleic acid content was 58 percent, its linoleic acid content 26 percent, and its linolenic acid content 3 percent. In normal soybean oil the linolenic acid content ranges from approximately 45 to 55 percent while the oleic acid content ranges from approximately 25 to 35 percent. It is thus seen that the chief change in composition which occurred in this oil was that resulting from a transposition of the relative contents of oleic and linoleic acids. cursory investigation of the stability of this particular oil did not reveal any outstanding characteristics.

An investigation during the past year of the distribution of phosphorus compounds in the soybean seed was undertaken by the analytical section of the laboratory and some of the results have already been published. It was found that only about 10 to 15 percent of the total phosphorus present in soybeans could be accounted for by the phosphatides, that is, the lecithins and cephalins. The largest fraction of the phosphorus was contained in the inositols which accounted for approximately 65 to 75 percent of the total phosphorus. In attempting to develop methods which might permit a more exact characterization of the proteins of the soybean, the solubility relationships of soybean protein have been studied in some detail. It was early found that from 90 to 95 percent of the total nitrogen of the soybean could be extracted with water at room temperature, and studies have been made to ascertain the influence of temperature, time, concentration, particle size, and such factors on this extraction.

A study of the solubility of soybean proteins, lecithin, and sugars in alcohol-water mixtures has also been completed. The experimental evidence suggests that the lecithin present in the soybean meal may be responsible for the completeness with which soybean protein is dispersed in ordinary water solutions. Studies have also been made for the purpose of developing a routine method for the differentiation between protein and nonprotein nitrogen of the soybean. The experimental work thus far completed indicates that trichloroacetic acid will prove to be a satisfactory agent for the extraction of nonprotein nitrogenous compounds but in concentrations much higher than have heretofore been recommended in the literature. If it is possible to develop a routine method for the determination of nonprotein nitrogen whereby a large number of samples may be studied in the course of a year, it is felt that needed additional information might be obtained on variations in nitrogen content of soybeans from different localities and of different varieties. Such information would be quite valuable in a number of important applications. Apparatus has been assembled for carrying out certain microchemical analytical procedures, and it is hoped that eventually complete microchemical facilities will be available for the workers in the laboratory.

Experiments have been continuously underway during the past year looking to improvement in the various determinations used in the analysis of the soybean. Among these studies the most extensive have dealt with comparative investigations of the estimations of the iodine number of soybean and other oils of higher and lower degrees of unsaturation by the Wijs, Hanus, Rosemund-Kuhenhenn, and Kaufmann methods. It is generally admitted that the present status of methods for the determination of iodine numbers is not entirely satisfactory. However, the results so far obtained in these comparative experiments indicate that there would be little substantial gain in changing from the Wijs

method now used to any of the other methods studied.

Considerable experimental work has been done during the past year on the development of soybean oil protective films and coatings. This has been especially true of 100 percent soybean oil varnishes. A large number of experiments dealing with variations in resin, driers, methods and duration of bodying, and types of soybean oil have been completed. These have led to the development of a number of very promising varnishes characterized by the use of clarified, nonbreak, or alkali-refined soybean oil, synthetic and ester gum resins, and cobalt driers. Some 50 varnishes are now on undergoing exposure tests. Some of these have been exposed for more than a year on 45 degree south panels and are standing up exceedingly well with practically no checking or peeling and with an excellent retention of gloss. The resistance to acid, alkali, and water of many of these soybean oil varnishes is also excellent.

While ten years ago the drying rates of these varnishes would be considered very good, today, with varnishes available which will dry in two hours, the



The Soybean Industrial Laboratory impresses one as being well equipped.

soybean oil-phenolics which in our hands dry free from tack in some four to six hours and which will permit the application of successive coats on successive days, do not measure up to the very stringent drying requirements now specified for some modern-day uses. The laboratory is carrying out extensive experimentation in an effort to bring the

(Continued on page 20)

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### OUR FRONTISPIECE

The picture on the front is that of Edwin M. Bruce retired professor of chemistry of Indiana State Teachers College of Terre Haute who was honored with a special dinner sponsored by the Indiana High School Chemistry Teachers Association at its last meeting.

### SUPPORTING OUR JOURNAL

Advertising is an important factor in supporting our journal and in fact contributes more at present than do the associations that it serves, so it seems appropriate that attention be called to the service rendered by the commercial firms whose advertisements appear regularly in The Science Teacher. These companies are supporting our work whole heartedly in the interest of promoting educational advancement through cooperative efforts of associations. They are doing this without any attempt to influence our work in any direction. It would appear then that we should not overlook this service and at least take time occasionally to express our appreciation if in no other way than by writing them a letter. After all, the men behind these commercial enterprises are not concerned solely with financial income. They are worthy people who will appreciate your favorable reaction. As potential users of their products we should not forget that the books or laboratory equipment and supplies they sell are worth consideration in supplying our needs.

### URBANA MEETING

The science sections, both biological and physical, of the High School Conference this year again appear most promising if we may judge from the program and talent offered. Teachers of physics as well as of chemistry will not want to miss the noon luncheon where there is always a splendid opportunity to get acquainted and talk problems over. The luncheon is being arranged by Mr. Glenn Tilbury of Urbana High School. President John C. Hessler of James Millikin university who is president of the Illinois Chemistry Teachers Association will preside as toast master.

### INDIANA MEETING

President Charles D. Dilts of the Indiana High School Chemistry Teachers Association informs that they hope to have a meeting this month at the State meeting. The regular meeting of the Association, however, comes in the spring and will be held at Muncie this year. There the Ball Brothers glass manufacturing plant will be of interest.

## A Sixty Minute Science Period

S. A. CHESTER\*

Bloomington High School

Bloomington, Illinois

In order that this association may be of service to its members, your secretary recently framed a questionnaire concerning adjustment to the 60 minute laboratory period. Information was sought chiefly to determine first, the extent of the change from double period laboratory work to the single period plan, second, the effect of the change on the teaching situation, third, the attitude of teachers toward the change and fourth, what remedial measures were favored.

This questionnaire was sent to 115 chemistry teachers in Illinois high schools and to 60 in other scattered states. 85 replies were received and tabulated. This paper will be concerned chiefly with pertinent facts gained from these.

Quite evidently the trend is toward the adoption of the sixty minute period in our high schools. The North Central Association accredited a total of 2667 high schools for the year 1936-37. 41 per cent of these scheduled class periods of 55 minutes or more. This was an increase of more than three per cent over the preceding year. North Central Association data is not yet available for the school year, 1937-38, but an idea of the extent of the change can be obtained from the fact that out of 50 schools reported as on the single period schedule, seven made the change this year. Twenty four of the 50 schools made the change during the past five years. Three of the thirty-five teachers on the double period laboratory schedule reported an anticipated change to the single period plan next year.

No instance of a return to the seven period laboratory schedule were reported as having taken place during the past seven or more years. One school is to restore this arrangement next year.

In many schools allowing 5 periods per week for chemistry, the class period is not actually 60 minutes in length. 22 per cent of these reported periods of

55 minutes, 16 per cent reported 57 minutes, while only 41 per cent reported a full 60 minute period. Some reported frequent curtailments due to special school events.

For purposes of simplicity we shall refer to those schools scheduling class periods of 55-60 minutes duration and allowing only 5 periods a week for chemistry as type A. Questionnaires were returned from 50 such schools. Those allowing 7 periods a week for chemistry, including two double periods for laboratory work we shall call B schools. Questionnaires were returned from 35 of this type. Two schools reported six periods a week for chemistry, while one reported ten periods. These were too few in number to be of any consequence.

What effect has this change made in teaching practices? First of all, it has resulted in a greater load for the chemistry teacher. In type A schools, five classes is the general rule, while in type B schools few have over four classes. Most teachers of type A schools reported an additional home room session averaging 20 minutes in length. Sixty six per cent are sponsoring a club.

About 30 per cent of each group stated they carried on student project work during laboratory periods, indicating perhaps, that if teachers really want project work, they will find time for it. Among those in type A schools, there was considerable difference of opinion as to the need of carrying experiments over into a second period. There may be considerable difference in the types of notebooks used. Most every one agreed that students felt rushed in attempting to complete an experiment in one hour. Only 26 per cent considered it necessary to omit essential work. Very few are of the opinion that the shortened period increases the likelihood of accidents. 62 per cent stated that more experiments were handled by the demonstration

\*Secretary of Illinois Association of Chemistry Teachers.

(Continued on page 16)

## Field Work in High School Biology\*

MARGARET MIDDLETON

University of Illinois

Urbana, Illinois

Dr. O. D. Frank of the University of Chicago High School has published and repeatedly used a project which he calls BETO; B for biological, E. for experience, T for thought, and O for observation—biological, experience, thought and observation. If a high school biology course is built around this "motto" as its guiding principle, awareness and knowledge of the living world must necessarily be built up in the students' minds. But this cannot be done in the classroom alone. Nowhere except in the field can certain types of experience and observation be gained. And so one of the major phases of a biology course must be field work.

Even in the city this is true. A different type of work will have to be done there but an ingenious teacher always can find ways in which to acquaint a class with field study by adapting or reorganizing the more common methods of the country schools.

However, field work, in order to be successful, requires much thought and planning for the teacher. A certain amount of "free lancing" on the part of the individual student is a good way to develop originality and general appreciation of nature, but to depend upon this type of field work alone is too liable to develop onesided ideas of facts as well as careless methods.

Many of the teachers of biology in the high schools of Illinois—as well as in other states—have graduated with biology majors from accredited colleges which give little training in field work—especially in planned and conducted field work. And so these young teachers start their teaching with an enthusiasm to develop this "biological experience, thought, and observation" but with very little knowledge of how to plan the field part

of the course or with little in the way of practical written help to be found. Most teachers need only a few suggestions or a bare outline as a starter; and that is about all that is practical or possible to furnish, for no two teachers can present successfully the same thing in exactly the same way. Each one must work out his own method of presentation according to his own ability and according to the needs of the varying groups of students under his supervision.

But it is not only the new teacher who needs and appreciates any helpful hints for field work. Teachers with many years of experience are most happy to be able to find new ideas which they can adapt for their own classes.

The following suggestions, hints, outlines, and references are presented for whatever use or aid they may be in planning field trips. These plans have been presented by different active teachers in the state and have been used successfully by them in their own classes. In most cases only a brief synopsis of the individual plans as submitted by the various teachers is included here. Many of these may be used either as conducted class field trips or as individual student work.

### General Procedures

(from P. K. Houdek, Robinson, Ill.)

#### Discipline:

To avoid disturbing other classes, students are marched out in silence from the biology laboratory to a point some distance from the building. During the remainder of the trip they are allowed to converse with each other in an ordinary manner. While instructions are being given and observations being made, close attention is required. Enroute to and from the location and during instructions and group observations the students are required to stay in a reasonably close group. Close attention to these requirements on the first two or three trips make later trips easily handled.

\*Report of sub-committee of State Biology Curriculum committee.

**Signals:**

A whistle is carried on all trips. Two signals are used. One blast means "Attention"; two blasts mean "Assemble at Instructor's Location".

**Recess or Free Period**

The tendency to play while out in the field can be controlled to a large extent if it is recognized and some provisions made for it. On practically every trip, provision is made for a five to ten minute recess after the work is done and before the return trip is started. With a few warnings they are told to do as they wish for the next five or ten minutes when the whistle will bring them in.

Slow students are often required to use this time to complete their work. Additional work is never suggested for this time but usually more than half of the students take this time to make further observations and discoveries.

**Tree Study**

1. (From L. A. Astell, University High School, Urbana, Illinois.)

Consists of two mimeographed sheets to be given to each student beforehand:

- a. Map of campus, some particular wood, or plot of ground. Various buildings, walks, paths, or other landmarks are outlined and the positions of the trees to be studied are indicated by numbers.
- b. Ruled chart to be filled in by the student. Contains a list of the trees studied down the left-hand side of the page and the following column heads across the top:

Branching	Buds
excurrent	opposite
deliquescent	alternate
Shapes	pubescent
vase	glaucous
columnar	glabrous
conical	large
symmetrical	medium
irregular	small
Bark	Foliage
color	dense
rough	thin
smooth	large
plates or scales	medium

small	cordate
deciduous	spatulate
evergreen	entire
simple	crenate
pinnately compound	dentate
palmately compound	serrate
pinnately net veined	pinnately lobed
palmately net veined	palmately lobed
parrallel veined	glabrous
Leaves	glaucous
linear	pubescent
ovate	stipules present
lanceolate	stipules absent

2. Environment of a tree. (From P. K. Houdek, Rominson, Illinois.)

This trip is best conducted in a woods but can be quite successful in a park. Each student is required to take pencil and paper. Class is seated about the foot of a tree with instructor standing by to point out how to make the study of the factors in the environment of a tree. They are required to make three lists of factors according to the following outline:

- a. In and on the tree itself.

Examine bark for insects, spiders, spider webs, insect holes, sap-sucker holes, hairs of grazing animals, mosses, lichens, algae, cuts, wounds, sand, and dirt. Look among the branches for birds, insects, spiders, galls, partially eaten leaves, broken branches, fungus growths, etc. List all items.

- b. Here list all factors within reach of the tree's branches that are not included in the first list—everything on the ground within this limit, such as: bushes, herbs, mosses, sticks, stons, leaves, animal remains, soil type, animal homes, etc. Examine the area above this circle for the branches of other trees or shrubs noting whether they are above or below the branches of your tree.

- c. General surroundings.

In this list include all items of the environment not included in the lists (a) or (b). Be sure to include such items as temperature extremes, prevailing winds, topo-

(Continued on next page)

graphy of the location, rainfall, nearness to dwelling, near-by factories that might produce harmful gasses, distance to the nearest tree, size of woods, kinds of trees in the woods, etc.

After these instructions have been given and questions about them answered each student is assigned a tree to study. The first observations are the kind of tree and a brief description of it. Students stay with their trees until called in by the whistle—for about twenty minutes. Then various students are asked to read parts of their notes for comparison. All students keep their notes and write them up in the next laboratory period.

### Flower Study

(From L. A. Astell)

1. Sample of a chart to be filled in by the students:

Family	Additional Characteristics	Locality
Araceae		
(The members of this family have a peppery juice).		
Jack-in-the-pulpit		
Camelinaceae		
(Herbs with sticky juices and leafy stems)		
Spiderwort		
Day flower		
Etc.		

2. Record of plant analysis—particularly for a herbarium.

Root: Kind:.....  
 Stem: Class:.....; Character:.....; Mode of growth:.....; Height:.....  
 Leaves: Arrangements:.....; Parts:.....; Kind:.....; Shape:.....  
 Flowers: Positions:.....; Kind:.....  
 Calyx: Number:.....; Form:.....; Insertion:.....  
 Sepals: Number:.....; Shape:.....; Aestivation:.....  
 Corolla: Color:.....; Form:.....; Insertion:.....  
 Petals: Number:.....; Shape:.....; Aestivation:.....  
 Stamens: Number:.....; Length:.....; Insertion:.....; Filament:.....; Anthers:.....  
 Pistil: Number:.....; Kind:.....; Style:.....  
 Stigma: Number:.....; Shape:.....  
 Ovary: Number of cells:.....; Placentation:.....; Number of ovules:.....  
 Fruit Kind:.....

Order:                      Family:  
 Genus:                    Scientific Name:  
 Species:                  Common Name:  
                                 Date:

### Weed Study

(From W. Wilson, 400 Nat. Hist. Urbana, Illinois).

One of the main purposes of such a trip is to show to the student that weeds are more than a composite group of plant pests. Weeds have definite interesting features about them as well as great economical importance. The following is a sample of observations to be pointed out by the teacher:

1. Two or three salient anatomical differences or peculiarities plus an explanation of the plant's bearing upon the environment of man. Do not merely warn against poison ivy but point out facts that will be of future aid in recognising the plant.

2. Particular environment in which the plant is found.

3. Type of growth, manner of seeding, etc.

4. Why a plant once considered a weed (e. g. sweet clover) may find a definite place in our system of agriculture.

### Field Study Furthered by Contests

(From Charlotte Young, 200 Nat. Hist., Urbana, Illinois.)

1. Tree Baseball:

Tests knowledge of species and stirs up interest. Divide the class in two teams. Four chairs or other objects represent the diamond with the teacher as umpire. The pitcher from one side describes a tree or twig and the batter "strikes" of guesses at it. Three "strikes" is an "out". If he "hits" them, he goes to first base and the next batter is "up". Have short innings so each team may have a chance, or else play only one inning at a time.

2. This contest may be used for either trees, birds, or flowers.

After having studied the particular group, have a field trip or series of trips to test the information learned. Choose up sides and start at a common point with a definite amount of time for the search and classification. Each side hunts for species which they can identify and of which they can collect evidence. At

(Continued on page 20)

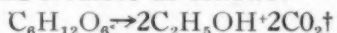
## Ethanol by Fractional Distillation

Shortridge High School

RICHARD MARTZ and CHARLES GOOD

Indianapolis, Indiana

Ethanol may be prepared in a number of ways. It may be prepared from dextrose and levulose as follows:



Yeast is added to this because during the growth of yeast it secretes a substance known as zymase. This enzyme makes possible a change from dextrose, or levulose, to alcohol.

A mixture was made consisting of the following ingredients: 500cc of "Karo" transparent, highly refined corn syrup; one cake of baker's yeast; and a 200cc batch of a 10 per cent solution containing 10 gm each of potassium phosphate, magnesium chloride, and calcium nitrate in one liter of water. The purpose of this last solution was to stimulate the growth of the yeast. The whole mixture was then diluted (with distilled water) to one gallon. The mixture was then allowed to sit for five days in a warm place. During this time the yeast grew and carbon dioxide was given off.

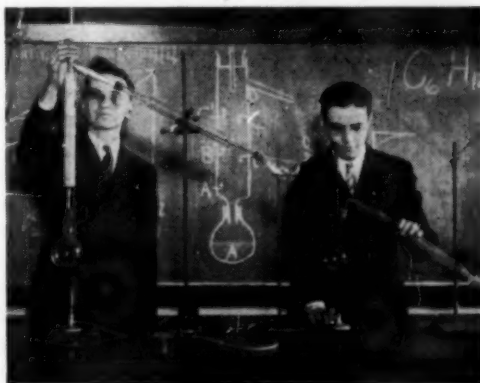
The mixture was distilled in an ordinary laboratory still. This mixture (in the boiler) had a boiling point of about 130 degrees centigrade. Boiling stones were also necessary, as the solution bumped badly. Half of this was allowed to distill over, and the remainder was discarded. This distillation removed the yeast, and inorganic salts, from the solution, and raised the ethanol content from about 10 per cent to about 20 per cent.

It was then placed in a fractionating still, and fractionated at a temperature between 84 and 87 degrees C. The boiling point of this solution (in the boiler) was 98 degrees C., but only that which fractionated off at temperatures between 84 and 87 degrees was kept. From one half gallon of distillate, only 200 cc of fractionate could be collected. This was between 90 and 96 per cent ethanol, and burned with a hot flame.

An attempt to use glass fractionating columns failed, as they were not annealed correctly. Because of this failure, a copper column of the humped type was used. This was 56 cm long, and 2.5 cm in diameter. The body of the column

was wrapped in asbestos paper in order to hold the heat inside. The interior was filled with glass beads.

The 96 per cent ethanol solution was mixed with calcium oxide and heated (using a water bath) to 60 degrees C. It was permitted to stand for a week, and then refluxed for an hour. After refluxing, the mixture of alcohol and calcium oxide was distilled. The distillate was tested both with anhydrous cupric sulfate, and with potassium permanganate; the test being based on the fact that these salts are soluble in water, but not in alcohol. Any water present would tend to



dissolve these salts and turn the colors of their respective ions. A minute amount of water was found. When these mixtures were refluxed and distilled, all open places in the apparatus were closed with drying tubes, as moisture from the air could change the water content of the alcohol. The refluxing and final distillation were done with the aid of a water bath. The temperature of the water in the water bath was 99 degrees and the ethanol solution inside boiled vigorously. Pure ethanol boils at 78.3 degrees C. About 60 cc were collected.

The following reference books covering this subject were used: "Laboratory Practice of Organic Chemistry"—Robertson; "A Course in General Chemistry"—McPherson and Henderson; "Experimental Organic Chemistry"—Norris; and also "Handbook of Chemistry and Physics"—Hodgman.

## Building a Real Chemistry Course

CARROL C. HALL

Springfield High School

The lack of a basic philosophy for the American High School has led to a curious mixture of offerings generally designated as the high school curriculum. By various and devious paths the high school pupil may acquire sufficient credits to be graduated. As a consequence this exposure to various informational samplings and its consequent effect upon the pupil has rightly led to criticism of public education at the secondary level.

The two dominant and contrasting point-of-view have been (a) that the high school course is primarily that of college preparation and (b) that the high school course should be practical in its purpose and make-up, in other words the vocational point-of-view.

High school chemistry has been predominantly organized on the first point of view. The various attempts to organize the high school chemistry course from the practical viewpoint have been fragmentary and in the main unsatisfactory. It is the purpose of the following discussion to point out some of the recent trends in the organization of high school chemistry and from them infer what is ahead in the development of the course.

### The Historical Background in the High School Chemistry Course

Fay in his *History of Chemistry Teaching in American High Schools* states that chemistry has been firmly established in the secondary school curriculum since about the middle of the nineteenth century. This fact makes high school chemistry a traditional subject. This traditional aspect of the course makes it particularly difficult to reorganize along the lines of contemporary educational thought. Recent surveys have noted the conservatism of organization in the high school chemistry course.

Other characteristics of the subject also tend to make its organization dif-

ficult. Among them might be cited its inherent difficulty of being complex, the wide range of material covered, and the fact that it came into the secondary curriculum from the college course.

### Attempts to Reorganize the High School Chemistry Course

In attempting to reorganize the high school chemistry course two types of activity have been represented. The first type is that of organized groups and second those of purely individual innovation.

The expression of the organized activities is found in the various committee reports of national educational societies. The individual activities find expression in various articles relative to the subject or proposed new courses in high school chemistry as published in the various science education periodicals.

In contrast to the theoretical aspects of the study by consulting the textbooks and course-of-study published in recent years other attempts to reorganize the high school chemistry course from its more practical side can be determined.

By using the above procedure the author has recently determined the trends now evident in the organization of high school chemistry.

### Recent Trends in the Organization of High School Chemistry

From the above mentioned study the following trends were evidenced in the organization of high school chemistry:

1. The trend is away from the emphasis on college preparation and practical applications to those of more social significance. The more recent aims and objectives emphasize a high school chemistry course organized for general cultural purposes.

2. There is a trend now to organize the materials of high school chemistry in such manner that the method of teaching is implied. This is shown by

the use of the project, contract and unit forms of organization.

3. There is a trend to apply the findings of educational and psychological research to the organization of high school chemistry.

4. There has been a trend of articulating high school and college chemistry. This trend is being less emphasized at the present time.

5. There is a trend to recognize the development of the individual pupil. At this point various educational devices are being used to develop certain attitudes, habits, appreciations, and skills in the student.

6. There are also evidences of a trend to integrate the chemistry course with the other subjects in the high school curriculum. This trend is not very pronounced at the present time. It is usually referred to in connection with the establishment of a science sequence of courses or the use of chemistry materials in other subjects.

From the foregoing evidence it must not be assumed that the organization of high school chemistry is being revolutionized. The organization of high school chemistry is going through a slow process of evolution. The major portion of the textbooks and courses of study that are in use today are organized essentially in the same manner as they were ten or fifteen years ago.

The trends do, however, seem to indicate that there is now being evolved a distinctive course in chemistry. This course can be truly designated as or called High School Chemistry—not an abbreviated General College Chemistry Course for high school pupils.

It is to the development of this real High School Chemistry Course that the remaining remarks in this article are addressed. The development of this course would fill a long-felt need in the secondary school curriculum.

#### **Bases Proposed for the Reorganization of High School Chemistry**

During recent years several attempts have been made to develop the high school chemistry course on the basis of life-preparation. A survey of the

Science Education literature reveals that these pandemic or cultural courses in high school chemistry have been organized on a number of different bases of organization. The following have been listed: (1) Using the course content as now set up for college preparation, (2) a course organized on the basic principles of chemistry, (3) courses dealing with the practical application of chemistry in home and industry, and (4) a course designed for 'consumer education.'

Of the above listed courses the one based on the basic principles of chemistry seems most likely to meet the requirements of a high school course. The course designed for consumers is the latest development and meets a need long neglected in secondary instruction.

#### **The Basic Educational Problems**

##### **To be Met**

The basic educational problems in developing a distinctive chemistry course for high school pupils include the following:

1. A compromise must be made between the college-preparation emphasis and the practical application point-of-view. In other words a course must be developed to meet the needs of all the pupils who elect the course.

2. An attempt must be made to balance the amount of theoretical and subject matter of more practical nature. In other words, preserve the basic contributions of chemistry to the field of science that are applicable to the developing of an appreciation of the subject. To the development of the residual knowledge necessary for complete living. Practical applications to illustrate theory in use.

3. After the basic principles to be taught have been determined, the next step is devise ways and means by which they can become well-grounded in the pupil's intellectual make up. This factor is often neglected in the various attempts to 'modernize' high school courses.

4. Devices must be incorporated in the course to develop the scientific attitude.

(Continued on page 18)

**PROGRAM FOR SCIENCE SECTIONS**  
**ILLINOIS STATE HIGH SCHOOL CONFERENCE**

UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS

FRIDAY, NOVEMBER 4, 1938

**Physical Science Section**

9:00 A. M. — PHYSICS BUILDING

Chairman: T. A. Nelson, Decatur High School, Decatur, Illinois

"Recent Developments in Visual Aids"—Lyle Stewart, Oak Park-River Forest High School, Oak Park, Illinois.

"Discussion of Electro Magnetic Radiations"—Dr. R. J. Stephenson, University of Chicago.

"Processing of Corn in the A. E. Staley Plant"—Dr. R. E. Greenfield, Staley Mfg. Co., Decatur, Illinois.

Business Meeting.

"New Frontiers for Smart People"—Dr. Jams S. Thomas, President, Clarkson Memorial College of Technology, Potsdam, New York.

12:00 NOON—PHYSICAL SCIENCE SECTION LUNCHEON

University Place Christian Church. Price 60c.

Luncheon Speaker—To be announced later.

Send in reservations at once to Glenn Tilbury, Urbana High School. No reservations can be made later than 9:30 a. m., Friday, Nov. 4.

**Physics Section**

2:00 P. M. — PHYSICS BUILDING

Chairman: Nellie F. Bates

"Making Physics Practical"—Dr. Paul Belting, University of Illinois.

"Physics and the Automobile"—Dr. James Thomas, President of Chrysler Institute of Technology, Detroit, Michigan.

"The Pro and Con of Workbooks"—William Harriman, Mt. Sterling High School.

"Making Physics Practical Through Visual Aids"—W. C. Dollahan, Pekin High School.

"Putting Pep into the Physics Course"—R. W. Woline, Gillespie High School.

 **Chemistry Section**

Meeting held under auspices of Illinois Association of Chemistry Teachers

2:00 P. M. — PHYSICS BUILDING

Chairman: C. A. Gross, Carbondale High School, Carbondale, Illinois

"Progressive Education Looks at Science Teaching,"—T. A. Nelson, Decatur High School, Decatur, Illinois.

"Trends in Subject-matter Content"—Willard L. Muehl, J. Sterling Morton High School, Cicero.

"Trends in Subject-matter Organization"—M. Curtis Howd, Hononegah Community High School, Rockton.

"Recent Developments in Diagnostic Testing"—Seth A. Fessenden, Eastern Illinois Teachers College, Charleston.

**Change in dues:** Dues of members of The Illinois Association of Chemistry Teachers are now \$1.00 per year. Of this amount 50 cents goes to the support of The Science Teacher. Send your dues for the year to S. A. Chester, Secretary, Bloomington High School, Bloomington, Illinois.

# **Announcing--- A New Chemistry Text**

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## **4 New Science Guides**

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**Chemistry Guide and Laboratory Exercises by McGill and Bradbury**

**A Learning Guide in Biology by Downing and McAtee**

**A Learning Guide in General Science by Boyer, Clark, Gordon, and Shilling**

Each of these books is an integrated laboratory manual, study guide, review program, and complete objective testing program under separate cover—all in one—for the price of the average laboratory manual. Each is for use with any standard text in its field.

These new science guides allow the teacher who desires it to use a library method of study, or a contract method of study, or the Morrison unit plan, or the plan of working experiments before classroom study is started.

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## ILLINOIS STATE HIGH SCHOOL CONFERENCE

UNIVERSITY OF ILLINOIS

FRIDAY, NOVEMBER 4, 1938

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### Program for Biology Section

9:00 A. M. — MORNING SESSION — 225 Natural History Building

Chairman: Grace L. Cook, Champaign High School

"Effective Usage, Arrangement and Organization of the Laboratory Space"—J. Roy Byerley, Assistant Superintendent of Public Instruction, Springfield.

"Suggestions for Effective Field Trips"—V. G. Catlin, Proviso Township High School, Maywood, Illinois.

Report on the Meeting of the National Association of Biology Teachers—P. K. Houdek, Chairman and Secy.-Treas., N. B. A., Robinson Township High School, Robinson, Illinois.

Report on the Work of the Curriculum Revision Committee in Biology—F. C. Hood, Assistant High School Visitor, University of Illinois.

"The Coming of Man"—Dr. Faye-Cooper Cole, Head of Department of Anthropology, University of Chicago.

"The Making of Anatomical Models in America"—Alfred Medendorp, Denoyer-Geppert Company.

2:00 P. M. — AFTERNOON SESSION

Chairman: Grace L. Cook, Champaign High School

Secretary: Mary R. Earnest, Decatur High School

Business session.

"Bacteriology in High School Biology"—Dr. F. W. Tanner, Head of Department of Bacteriology, University of Illinois.

"The Biology-Minded Community"—Dr. E. M. R. Lamkey, Illinois State Normal University, Normal, Illinois.

"Western Wild Flowers and One Humming Bird's Family" (Unusual Moving Pictures in Color)—E. R. Hoff, Freeport High School, Freeport, Illinois.

Display of Student Projects, in charge of Chas. B. Price, Thornton Township High School and Junior College, Harvey, Illinois.

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### Notice

To the Members of the Illinois Biological Association:

You are urged to assist our committee in arranging a student project display for the High School Conference. Your projects may be new and very helpful to some other teacher, so help in this worth-while undertaking by bringing one or more student projects to the conference.

Please notify Mr. Chas. B. Price, Thornton Township High School, Harvey, Illinois, as to the amount of space you desire for your projects.

GRACE L. COOK, President.

**NATIONAL BIOLOGY GROUP FORMED**

On July 1, 1938 in New York City was held the organization meeting of the National Association of Biology Teachers.

Fifteen delegates representing approximately 1500 pledged members in thirty-five states adopted a constitution, elected their officers and established their journal which will be known as THE AMERICAN BIOLOGY TEACHER.

The purpose of this association as stated in the constitution is to organize the biology teachers on a National basis by local units in order to spread vital and useful biological knowledge to the general public; encourage scientific through their journal to make available to biology teachers information concerning the selection, organization and presentation of biological materials.

This new association was sponsored by the committee on biological science teaching of the Union of American Biological societies. Dr. Oscar Riddle of

Cold Spring Harbor, N. Y. is chairman of the committee and Dr. D. F. Miller of Ohio State University is the committee's field representative.

The officers of the association are as follows:

President—Mr. M. C. Lichtenwalter, Chicago, Ill.

President-elect—Mr. Malcolm Campbell, Boston, Mass.

First Vice-President—Mr. George W. Jeffers, Farmville, Va.

Second Vice-President—Miss Lucy Orenstein, New York, N. Y.

Secretary-Treasurer—Mr. P. K. Houdek, Robinson, Ill.

Acting Editor-in-chief—Mr. I. A. Herskowitz, New York, N. Y.

Managing Editor—Mr. J. S. Mitchell, Lexington, Ky.

Enquires concerning membership and subscription to the journal should be sent to the Secretary-Treasurer, Mr. P. K. Houdek, Township High School, Robinson, Illinois.

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### SIXTY MINUTE PERIOD

(Continued from page 5)

method than were under the double period plan.

Apparently chemistry teachers of the type A schools are turning to the printed workbook as an aid in offsetting the handicap of the added teaching load. Type A schools use the workbook in 56 per cent of the cases reporting, whereas it is used in only 31 per cent of the type B schools. Only 12 per cent of the teachers in type A schools have the students write their own laboratory notes completely.

Teachers were asked to state whether or not they considered the 60 minutes laboratory period seriously detrimental to the teaching of high school chemistry. Those of type A schools answered 62 per cent "no," 34 per cent "yes," while those of the type B schools answered only 15 per cent "no," 37 per cent "yes," the remainder being non-committal. Apparently those who are most afraid of the single laboratory period are those not using it.

We might well point out here some of the arguments presented in favor of the single sixty minute period. Administrators, constantly beset by demands for financial retrenchment, find the single period a means of effecting considerable saving in salaries and building space, and of handling more students under limited budgets. The smoothness of operation of such a schedule is particularly appealing.

Several chemistry teachers point out that five 60 minute periods give the student as much time in chemistry as seven 43 minute periods, with the added advantage that the time may be spent in laboratory or class room as the occasion demands. This flexibility makes possible a closer correlation of laboratory and class work. It also makes possible spending several days in succession in the laboratory, so that a series of closely related experiments may be completed before the thread of association has been broken.

On the other hand, many principals insist that about 20 minutes of the class period be devoted to study. This is, however, a supervised study period, and can be used in leading the student into desir-

able channels of reading and learning.

Several think a curtailment in the laboratory period is desirable. Many students tend to waste time during a long period, but with a reduced laboratory session, will, if properly directed, plan their experiment before coming to the laboratory and work more efficiently. This argument is not altogether valid since there is a limit to the amount of work that can be accomplished in a given time by the most capable student with the best of intentions. Then, too we must not lose sight of the fact that high school boys and girls will be high school boys and girls.

Arguments presented against the single 60 minute lab period were numerous. Most common of all was the plain statement that much less laboratory work could be completed in the time allowed. It is undoubtedly the frequent experience of many that, after a student has assembled his apparatus, obtained his supplies from the reagent shelf and made a good start on the experiment, the period is over.

Again there is brought up the charge that careful scientific thinking is impossible with such a rush to complete assigned work. Many students make no attempt to comprehend the reactions they observe but seek to get information from the text or from the notebooks of their fellow students.

In the words of a lady teacher of the southland, the experiment becomes something like a stage performance. Everyone is keyed up, breathless, waiting to pick up his cue. Things must go off as planned. If something goes wrong, the result is a dismal failure, for there is no time for repetition. Undoubtedly, such a situation is not suited to good scientific thinking. However, a type of laboratory procedure that avoids these difficulties should be evolved. Many believe it can be done.

Another objection is the increased difficulty for the slow students who cannot hope to adjust themselves to a short period. Some teachers object to the amount of after school laboratory work which is made necessary by the curtailment of periods. It becomes increasingly difficult to supervise the work of these students when the teacher has an increased am-

ount of demonstration material to set up, paper work to check over, and a greater number of routine tasks to perform.

In view of the objections raised, it is interesting to note that only one fourth, or 24 per cent of those in type A schools favored working toward a restoration of the double period plan. On the other hand 50 per cent favored accepting the change and planning laboratory work to fit the new situation.

In order to determine what other high school departments might be expected to offer more concrete assistance than mere expressions of sympathy in voicing disapproval of the short lab period plan, teachers were asked to name other departments objecting. The physics teachers seemed to be the most outspoken in their objections, but being nearby, might have been heard more easily. Many named the manual arts department, while a few suggested the biology and home economics departments.

Do administrators consider a laboratory period of over 60 minutes impossible? Sixty per cent of those in type A schools answered "yes". 18 per cent offered the suggestion that administrators do not want laboratory periods of more than 60 minutes. It is pertinent to remark here that many chemistry teachers voice strong objection to a curtailment of the period to less than 60 minutes, a policy which unfortunately has been followed in some schools. Apparently some administrators feel that, since a reduction of 20 minutes has not brought disaster to laboratory work, a further nibbling of 3 or 4 minutes should not be of much concern.

Evidently the single lab period is here to stay, at least in many schools. Further need for retrenchment and the accepted convenience of this administrative device may result in its adoption in most of the other school systems.

Measures favored to offset the disadvantage of the shortened period were many and varied. Most prominent were these three, careful revision of experiments with a view to elimination of non-essential procedure, shortening of experiments and increasing the per cent demonstrated. Teachers already on the single laboratory period plan were not

quite as enthusiastic over increasing the amount demonstrated as were those on the older plan. Prominent also, was the policy of effecting a more complete preparation of chemical materials for the student. Few favored the plan of reducing the number of experiments, nor did many like the policy of having laboratory work three days a week. Several did suggest laboratory work five days in two weeks.

Not many felt that a more efficient set of student equipment could be made to help matters. Perhaps most of us assume that students are provided with a suitable set of desk apparatus including stoppers that fit the flasks, watch glasses that match the evaporating dishes and glass tubing that can be introduced into a number two stopper without a major operation.

We add with regret that one teacher of chemistry suggests the entire elimination of the student laboratory. One wonders where chemistry would be today without benefit of individual experimentation. Though teacher and student demonstrations may be used as substitutes for some of the longer and more difficult experiments, few will concede that the student can learn much real chemistry when he seldom handles materials himself.

Several interesting and perhaps fruitful experiments have been carried on by certain laboratory schools to compare the effectiveness of the single period and the double period plans. In most instances there appears to be little difference in the results obtained. It seems to be true that experimenters in this field have measured the results of each type of program by tests based on factual material. There is little evidence of attention being given to the development of methods of thinking, to habits of observation, to mechanical skills, or attitudes. Most of us will agree that a mere knowledge of facts is only one of several objectives of science teaching. Until educational experiments are designed to test and compare teaching programs from the standpoint of all of these objectives, they cannot be considered absolutely reliable.

In formulating a clear cut picture of the problem of the shortened laboratory period, one needs to get the viewpoint of

(Continued on next page)

these 50 teachers now facing the problem in reality. Nearly everyone is handling five classes together with a home room session averaging 20 minutes in length. The majority are sponsoring a club. There is very little time to set up elaborate demonstration apparatus, and with many students needing to complete experiments after school, it is difficult to carry on project work at that time. Other subjects compete for the student's interest and attention.

Parents and administrators are insisting that high school subjects be made more practical and more in keeping with the natural interests of the student who is not going to college. Is there any wonder, then, that most of these 50 teachers urgently appeal for a revision of the chemistry course to fit their needs? They are particularly anxious that experiments be rewritten to fit a 60 minute period.

Some few would dump the present structure overboard and plan an entirely new chemistry course. Most of us, however, would prefer evolutionary rather than revolutionary changes.

Might we suggest that several of the longer quantitative and gas generating experiments be designed for demonstration? Other experiments can be reduced in length by cutting out nonessential steps, simplifying apparatus and regrouping of parts. In some instances, sequences might be designed to run several days in succession. Optional parts can be arranged that will provide additional material for those who finish their work ahead of the others. Short, easily checked exercises might be included for the purpose of testing the student's comprehension of the principles developed in the experiments.

We believe that the sixty minute period is still on trial. It has not yet definitely proved its merit. If it should work to an advantage in our educational system, we can expect to see its universal adoption. If it is a failure, there will be sufficient criticism to force its abandonment. We cannot lose by planning and the best possible chemistry program under the circumstances and making an honest appraisal of the results under the new system.

## CHEMISTRY COURSE

(Continued from page 11)

5. The scientific method must be used in the development of the course and a lasting appreciation of this approach to problem-solving be developed.

6. A distinctive cultural contribution must be made through the high school chemistry course to the pupil. The use of the historical aspects of chemistry is an effective means at this point.

7. Some specific method of teaching that varies from the traditional pattern. The unit or contract-method of teaching both offer possibilities.

8. A balance must be developed between laboratory work and the lecture demonstration procedure. Each must be made to fit in a continuous sequence with each other.

Above all, it must be kept in mind that a strictly high school course is being developed.

### What Should the Development of a New High School Chemistry Course Accomplish?

First of all it will preserve the democratic spirit in secondary education. If we continue along the lines of college preparation (which is essentially vocational training for those planning to enter certain professions) the high school chemistry course is failing to meet the needs of a large group of individuals. If we swing to the other extreme and 'soften' the course there is danger of throwing overboard the contributions that the chemistry course should make to each individual who takes the course. The high school chemistry course must necessarily have value for most of those who make up the personnel of the secondary school.

Should an integrated science program be developed in the secondary school this new chemistry course would readily form an important link in the chain. As it is now organized and functioning the high school chemistry course is fast becoming the proverbial vermiform appendix. The new course must be organized with an eye to the future.

# PHYSICS OF TODAY

by

**JOHN A. CLARK**

Chairman, Science Comm., N. Y. City H. Schools

**FREDERICK R. GORTON**

Head Department of Physics and Astronomy, Mich. State N. C.

**FRANCIS W. SEARS**

Asst. Prof. Physics, Mich. Inst. Tech.

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MANUAL .80

**OUTSTANDING CONTRIBUTIONS:**

- (1) This text employs the inductive method throughout—question, experiment, principle.
- (2) It is up-to-the-minute in content and teaching aids, unrivaled in quality and force of diagrams and illustrations.
- (3) It integrates the understanding of fundamental physical laws with practical applications and illustrations in everyday life.

# BIOLOGY

by

**FREDERICK L. FITZPATRICK**

Teachers College, Columbia University

**RALPH E. HORTON**

Chairman Department of Science, Seward High School, New York City

**OUTSTANDING CONTRIBUTIONS:**

- (1) This book is organized upon seven principles, to each of which a complete unit is devoted.
- (2) It emphasizes the importance of the scientific attitude, in which special training is provided.
- (3) It provides a program of study which will lead to some understanding of the basic principles that govern affairs in our living world.

TEXT 1.76

MANUAL .48

TESTS .40

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**FEDERAL SOYBEAN RESEARCH**

(Continued from page 8)

drying time of soybean oil varnishes more closely to that required for such applications. The excellent durability and other characteristics of soybean oil varnishes, however, more than justify their use under certain conditions in their present state of development.

Arrangements for collaborative work on soybean oil paints and varnishes with other organizations have been established. Cooperative studies with the National Bureau of Standards on soybean oil paints will be undertaken soon. The preliminary arrangements have been completed, and tests will be carried out both at Washington and Urbana with paints made up under carefully controlled conditions and according to a number of different formulas. Collaborative work with the Norfolk Navy Yard has also been initiated. The Navy Department is apparently much interested in possible soybean oil varnishes and ship bottom paints. Such collaborative

work is welcomed by the laboratory because it is felt that it offers the best possibilities for sound and permanent expansion of the use of soybean oil in the field of protective films and coatings.

(Continued in December issue)

**HIGH SCHOOL BIOLOGY**

(Continued from page 8)

the end of the time the two sides compare lists to see which has won the prize.

**Bird Study**

1. (From L. A. Astell) In two parts:
  - a. Report to be handed in by the student (the following is a copy of this page); "The study of birds can be one of the most interesting things done in the biology course. The knowledge you obtain will be a source of pleasure and profit to you the rest of your life. While some birds are active at the time the field trip is taken by way of an initial introduction to our bird friends, many other birds are more active early in the

# PHYSICS

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morning and in the late afternoon. When beginning the study of birds, observations should be confined to the larger birds. If you can name the bird, do so; if not assign a number and take all the pertinent data which will help you to identify it later. Points to observe include:

Where found: on tree, bush or ground.

Size: Compare with a robin or a sparrow.

Form: Long, short, slender, plump.

Tail: Length and shape.

Beak: broad and pointed; broad and notched; sharp and hooked; long and slender; chisel-shaped; short and thick.

Legs: long, short.

Toes: how turned; webbed.

Prominent colors: differences noted on head, breast, back, etc.

Behavior: quiet, noisy, walking, hopping, swimming—nature of song.

Food: seeds, berries, insects.

Nest: shape, material, location, eggs—size and number as well as color.

#### Record:

Name of bird	Where found	Size	Peculiarities and habits
b.	Accompanying this sheet may be a list of birds with a few facts about each to help arouse interest:		
Bluebird:	destroys harmful insects.		
Wild fruit	encourages his presence.		
Blue Jay:	has been accused of some of the same crimes as the crow but he prefers acorns, tree seeds, grasshoppers, and caterpillars.		
Brown Thrasher:	eats some cherries and grains, but he eats so many destructive beetles that his good outweighs any harm.		

(Continued in December issue)

#### BIOLOGY BRIEFS

Biology teachers should become acquainted with the new publication, *Biology Briefs*, issued monthly and containing much helpful material for teachers. It is available free to biology teachers and may be secured by writing to the Denoyer Geppert Company, Attention H. Sigler, Editor, *Biology Briefs*, 5235 Ravenswood Avenue, Chicago, Illinois.

## THE DISCOVERY OF THE ELEMENTS

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## BOOK SHELF

**SCIENCE PROBLEMS. BOOK ONE**, by Wilbur L. Beauchamp, John C. Mayfield, and Joe Young West. 432 pages—size  $8\frac{1}{4} \times 5\frac{1}{2}$ , 328 pictures. Summer, 1938. Scott, Foresman and Company. First book of the junior-high school series of the Basic Studies in Science Program. (Books Two and Three will appear early in 1939.) \$1.28 list price.

Today everyone, at all age-levels, is interested in science, providing it is made understandable, and the reader is encouraged to turn the page and read more. But, up to now, writers and users of junior-high science texts have faced a common difficulty—that involved in their efforts to bring material and treatment down to the **level of understanding** of the twelve to fifteen-year old. Here is a book, however, which breaks away from the practice of rewriting high school science for the seventh, eighth, and ninth grades. This book stands as convincing evidence that the authors of **SCIENCE PROBLEMS** approached junior-high science from the lower grades upward and have really arrived at what science can be taught, interesting, practically, and thoroughly to youngsters of this age level.

After reading a few of the units, one is struck by the fact that **SCIENCE PROBLEMS** is not potpourri of science. The content is focused clearly on basic science principles involved in the understanding of large environmental questions. The approach is gradual and cumulative. Science principles involved in the solution of a complex environmental problem are developed separately, through simple problem sequences early in the book. When these principles have been developed to the extent that the child really understands them and can apply them, they are integrated in the solution of more complex problems. This is a very different approach from the all-to-common one which undertakes, all at once, to solve a big environmental problem involving too many new and intrinsically unrelated principles which cannot be developed ade-

quately. The result is inevitable confusion for the struggling pupil.

Just a casual glance at **SCIENCE PROBLEMS** is sufficient to show that this is the sort of book which wins children over and makes them want to study their lessons. Noteworthy are the modern interest-provoking and interest-sustaining mediums—striking cover, large page size, effective pictures, and personal tone. The vocabulary, sentences, and content have been carefully graded.

The organization of the book permits science to be included in the most crowded of curriculums. Compact units are broken down into problems, sub-problems, fascinating experiments, self-testing exercises, and summaries—allowing unity for a course which may meet only several times a week, as well as simplicity for an expanded science program.

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**PHYSICS FOR TODAY**

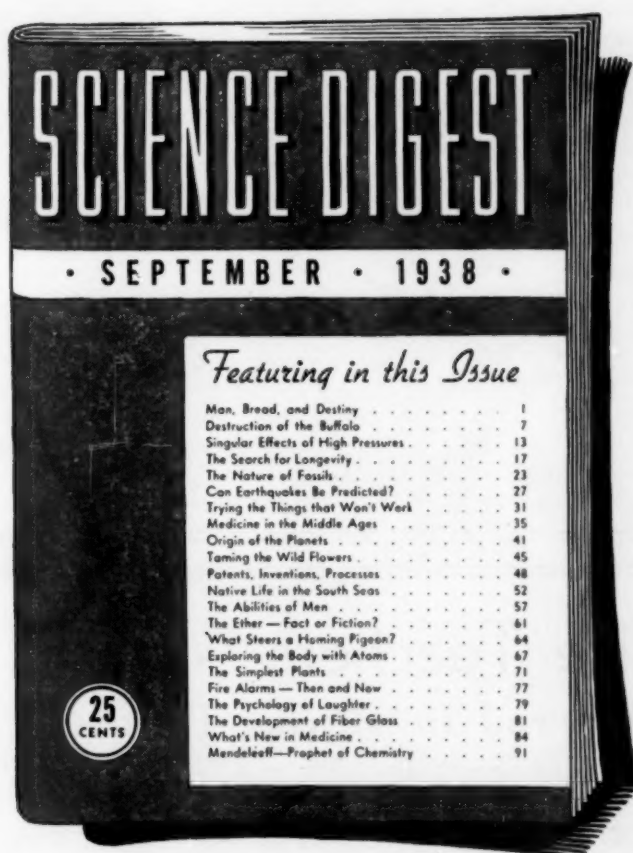

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Clark, Gorton and Sears  
Houghton Mifflin Company, 1938

Here is another valuable addition to the physics textbook list which unlike other subject fields is not yet overcrowded. This text is constructed according to modern educational trends. The content is broken into ten fundamental units and subdivided into chapters. Each unit is preceded by a preview of the material to be encountered and at the end is to be found new type tests covering the subject matter. Numerous questions and problems are interspersed throughout the chapters. These are of practical nature and valuable for teacher use in providing for individual differences. Chapter summaries of fundamental subject matter are of short review nature in outline form. The content throughout is based upon the experimental method of approach leading to deductive reasoning and was carried out in actual classroom practice before inclusion in the textbook. New discoveries and recent advances in physics are included making subject matter up to date.

(Continued on page 24)

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**PHYSICS FOR TODAY**

(Continued from page 22)

Of particular interest is the great array of diagrams and photographs which accompany fundamental physical principles, all new and of practical everyday value. These should be of considerable value from the teaching standpoint. In addition, fundamental mathematical data is accompanied by diagrams depicting problem facts. This approach should be of assistance to students slow in arithmetical understanding.

Italics are used for all new terms encountered. Important definitions and laws are set apart from the remainder of the content in black face type which is a commendable feature noted in many recent texts.

After a careful analysis of the text it is evident that the authors' aim "to present the fundamental laws and principles

of Physics in a simple, brief, and interesting way" is well realized. This necessarily means that a few aspects of physics have been slighted in abbreviating the content. Another point of criticism is that material on forces, motion, gravitation, work energy and power, are placed in separate units. It would seem advisable to group these into fewer divisions thus providing a more balanced group. The shortened index is also to be questioned. Present physics texts are as yet behind other subject fields in providing for reference readings and supplementary data which would be valuable to many teachers.

Schools contemplating a change of texts would do well to examine this new production. Its ease of comprehension by the student, modern character, and appealing features should bring about a deserved popularity.

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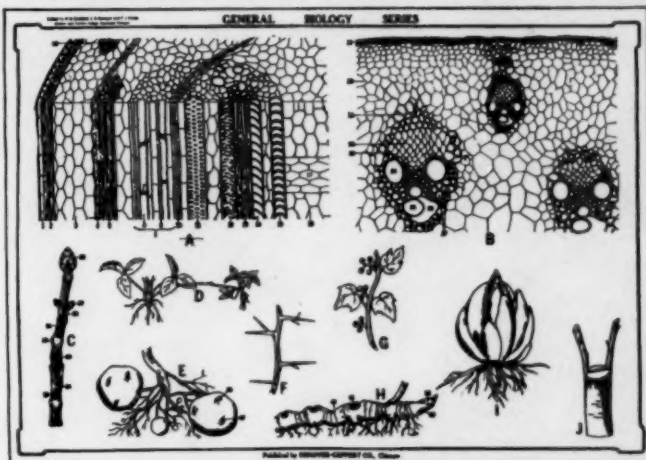


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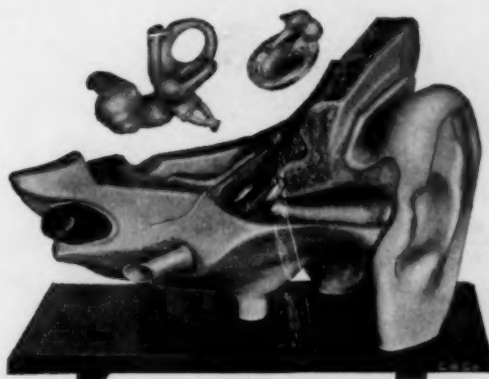
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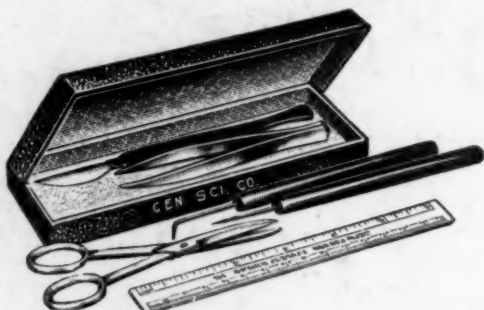
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